Quantization Distortion in Block Transform-Compressed Data
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Abstract
The popular JPEG image compression standard [1] is an example of a block
transform-based compression scheme; the image is systematically subdivided into
blocks that are individually transformed, quantized, and encoded [2]. The com-
pression is achieved by quantizing the transformed data, reducing the data entropy
and thus facilitating efficient encoding. It is well documented that block transform
compression schemes exhibit sharp discontinuities at data block boundaries; this
blocking phenomenon is a visible manifestation of the compression quantization
distortion. For example, in compression algorithms such as JPEG these blocking
effects manifest themselves visually as discontinuities between adjacent 8x8 pixel
image blocks.

In general the distortion characteristics of block transform-based compression
techniques are understandable in terms of the properties of the transform basis
functions and the transform coefficient quantization error. In particular, the block-
ing effects exhibited by JPEG are explained by two simple observations demon-
strated in this work: a disproportionate fraction of the total quantization error
accumulates on block edge pixels; and the quantization errors among pixels within
a compression block are highly correlated, while the quantization errors between
pixels in separate blocks are uncorrelated.

For the analyst attempting to extract quantitative information from block
transform-compressed data, the non-trivial spatial and correlational character of
quantization noise has potentially important consequences. Further, a predictive
distortion model facilitates the design and application of strategies for mitigat-
ing compression artifacts [3]. Hence a quantitative modeling of the compression
distortion pattern is desirable. In this work a generic model of block transform
compression quantization noise is introduced, applied to synthesized and real one
and two dimensional data using the DCT as the transform basis, and results of the
model are shown to predict distortion patterns observed in data compressed with
JPEG.

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References
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